

# MicroHydro

## The EcoHydro System™

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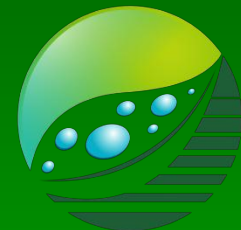
Sustainable, Low-Cost Renewable Energy

Presentation for:

The Vermont Energy & Climate Action Network Conference  
by Little Green Hydro, LLC, December 2012

[www.LittleGreenHydro.com](http://www.LittleGreenHydro.com)

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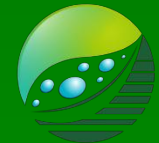
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# Highlights



- What is “MicroHydro?”
- How Does It Work?
- Local Action Opportunities
- MicroHydro: Right for Vermont

# What is MicroHydro?

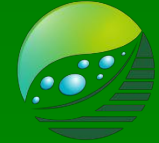


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- *Not* Legacy, Large-Scale Hydro

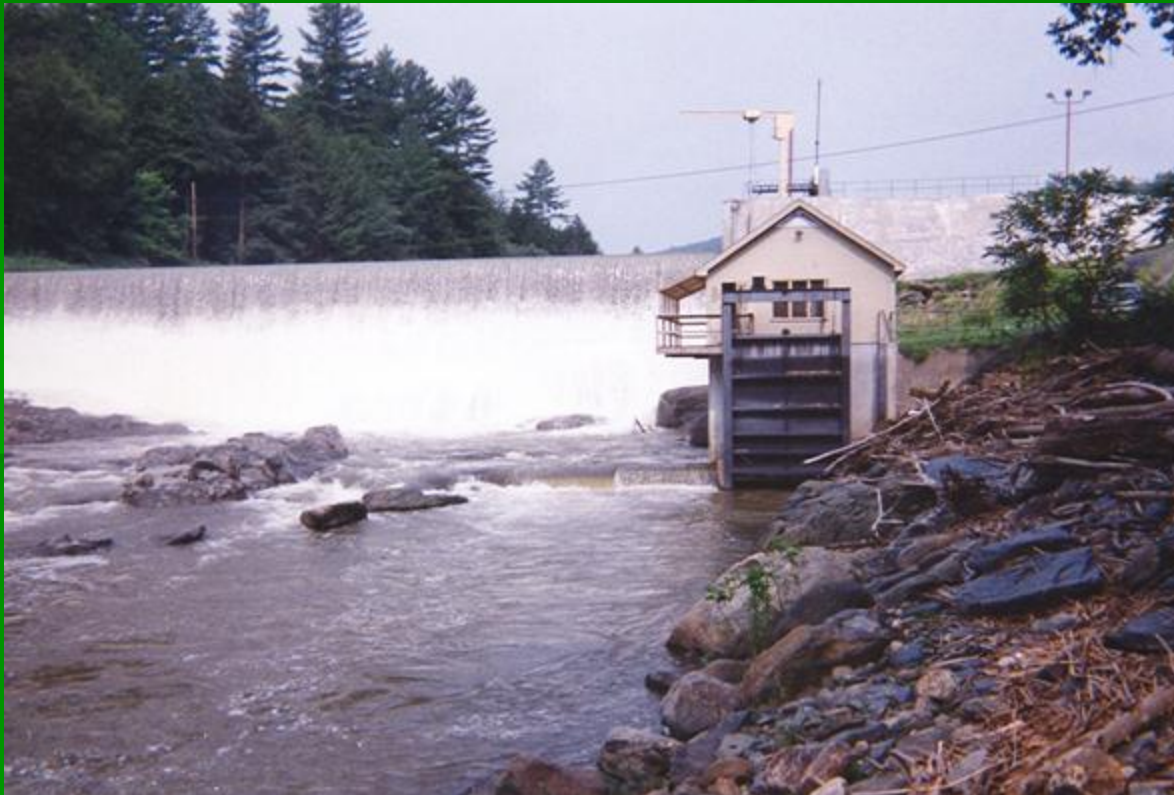


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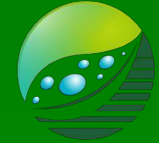


LittleGreenHydro

- *Not* “Small-Scale” Hydro



# What is MicroHydro?

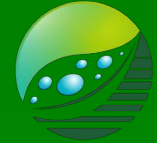


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- ***This*** is Micro-Hydropower!



# What is MicroHydro?



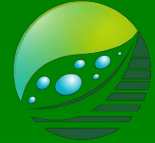
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**Definitions: see Wikipedia-*"micro hydro"***

- MicroHydro < 100kW
  - *The EcoHydro System™*
    - *Typically < 5kW*
- Small Hydro
  - 100,000 Watts (100kW)→5megaWatts
- Conventional, Legacy Hydro
  - > 5,000,000 Watts (5MW)

*(Hoover Dam – 2 gigaWatts, Three Gorges (China) – 22 gigaWatts!)*

# What is MicroHydro?



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- True Sustainable Hydro
- Ultra-Low Impact
  - *No Dams or Impoundments*
  - *No Significant Water Quality Impact*
  - *No Adverse Aesthetic Impact*
  - Ultra-Light/Advanced Components

# Supports VT Goals

## 90% Renewable by 2050



- Diverse, Small-Scale Renewables
  - Environmentally-Sustainable Solutions
    - Non-Industrial Approaches
    - Low-Impact Technologies
- MicroHydro is Viable ... Now
  - Environmentally Sustainable
  - Economically Viable
  - Technologically Sound
  - *Each* EcoHydro System Can
    - Replace 2.7 Tons of Coal; Avoid 7.0 Tons of CO<sub>2</sub>

Union of Concerned Scientists: [www.ucsusa.org/clean\\_energy/coalvswind/brief\\_coal.html](http://www.ucsusa.org/clean_energy/coalvswind/brief_coal.html)



# How Does it Work?



- The Intake Unit
- The Penstock/Hydraulics
- The Power Unit
  - Turbine/Generator, Electronics, Hydraulics
  - Water Return – 100% Natural Condition
- The Energy Storage Unit

# How Does it Work?

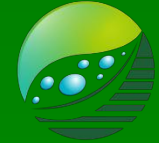


# How Does it Work?



Intake  
Unit

Penstock  
Pipe



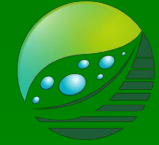
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# How Does it Work?



Power  
Unit

Turbine



# How Does it Work?

## High-Head/Low Flow Design

- High Head (Gravity)
  - Ideally, >100' hydraulic head (elevation differential)
- Very Low Flow
  - Small stream or brook is perfect
    - Conventional Hydro Needs “CFS<sup>1</sup>”
    - EcoHydro needs only “GPM<sup>1</sup>”
  - Intake Unit – “Run of River”
    - Placed in falling water
    - Natural - boulders, ledges, etc.

<sup>1</sup>CFS=Cubic Feet per Second; GPM=Gallons Per Minute; 1 CFS=488 GPM

# How Does it Work?

## What about the Winter?



- Our Terrain is Perfect!
- Yes, It Works in Vermont Winters!



# MicroHydro Example

## USDA/REAP Farm Project



- Large Central Vermont Dairy Farm
- Goals
  - Produce/Use Farm-Based Renewable Energy
  - Achieve Low Cost, Fast ROI
  - Rapid, Simple Installation Process
- EcoHydro System™ Installation
  - Actual Start Nov 15
  - Planned Completion Dec 23
  - Status: On Plan

# MicroHydro Example

## USDA/REAP Farm Project

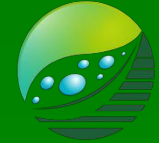


- Resource Profile
  - 168' Gross Hydraulic Head
  - 40 GPM Field Drainage Flow
- EcoHydro System Configuration
  - 1,200' 3" Penstock
  - 880' Power & Data Cable
  - 25 kWhr Power Unit
  - Standard "Grid-Disconnected" Mode



# MicroHydro - Solar PV

## Economic Comparison



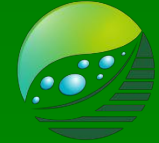
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- EcoHydro System
  - Cost/kWhr Produced ~ \$0.14
  - Capital Cost – 25kWhr system ~\$25,000
- Solar PV
  - Cost/kWhr Produced ~ \$0.64<sup>1</sup>
  - Capital Cost - 25kWhr system
    - 4.5 hrs avg insolation, requires 5.5kW system
    - Vermont installed cost @\$8/watt ~\$44,000

<sup>1</sup>SolarBuzz, Mar 2012 “Solar Electricity Prices” [www.solarbuzz.com/node/244](http://www.solarbuzz.com/node/244)

# MicroHydro - Solar PV

## Compatibility



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- MicroHydro / Solar PV Hybrid System
  - Highly Compatible Technologies
    - Shared core electronics
    - Commonality behind the meter
  - Seasonal Synergies
    - Solar PV output best in Summer
    - MicroHydro output best Fall through Spring
  - Benefits
    - Shared Costs
    - Enhanced Reliability
    - Grid Supportive and Stabilizing

# Taking Action

## Identify Opportunities



- Energy Efficiency is #1
- Larger Power Uses
  - Farms
  - Businesses/Nonprofits
  - Schools
  - Municipal Buildings
- Residences

# Taking Action

## Assess Feasibility



- Resources
  - Water Flow
    - Brooks, Small Rivers
  - Hydraulic Head
    - Elevation Differential
      - Delta: High->Low along Watercourse
      - Recommendation: 100' Minimum; 200' Superior
- Resource Assessment (S/W) Tools
  - Prospecting, Qualification, Configuration

# Taking Action

## Assess Feasibility



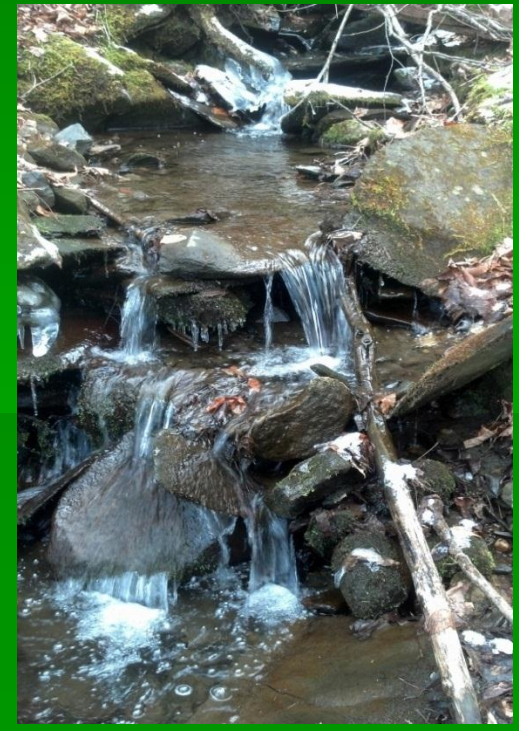
- Logistics
  - Ownership
  - Property Boundaries
  - Distances
    - Penstock, less than 1,000'
    - Power Cable; less than 1,000'
  - Increased Distance
    - Increases Capital Requirements
    - Decreases System Efficiency

# Taking Action

## Look Around!



- Examples of Viable Watercourses



# Vermont Can Lead



- Environmental Leadership
- Independence Culture
- Thousands of Potential Sites
  - Farms, businesses, small municipalities
- Vermont...

Can Become The MicroHydro Center!

# Summary

## MicroHydro...



- *Is Not* “Small Hydro” or “Legacy” Hydro
- *Is Sustainable!*
  - Environmentally, Economically, Culturally
- Supports Vermont’s R/E Goals
  - Small, non-industrial-scale, distributed
  - MicroHydro/Solar PV Hybrid
- *Is Ready to Help Us Today!*
- *...but...*



# Public Policy

## Regulation Blocks MicroHydro



- Watercourse Side
  - ANR, USF&W, EPA401
- Grid-Side
  - FERC, PSB, PURPA + *all above*
- Conflicting/Overlapping Regulations
- Costly Case-By-Case Approach
  - Varying/Vague Requirements
  - No Process, Timelines, Accountability

# Summary

## Closing



- Thank You!
- Questions...